

North Dakota Centers of Excellence Best Practices Review

Completed for



Representing

North Dakota
Centers of Excellence Commission

and

Legislative Interim Workforce Committee

Conducted by:



Thomas P. Miller and Associates

Building Assets through Knowledge & Innovation

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TPMA Project Lead:

Jim Wheeler
jwheeler@tpma-inc.com

Project Authors:

Jim Wheeler
Jason Lovell

1630 N. Meridian Street
Suite 430
Indianapolis, IN 46202

Main Office: 317-894-5508
Fax: 317-894-5370
www.tpma-inc.com

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Executive Summary

The North Dakota Department of Commerce and the Centers of Excellence Commission retained Thomas P. Miller and Associates (TPMA) to conduct a best practice review of North Dakota's Centers of Excellence (COE) program. Our task was to: 1) analyze the current Centers of Excellence program; 2) compare North Dakota's program to similar initiatives in other states; and 3) offer recommendations for taking the COE program to the next level.

Our focus was to obtain information and insights on the state of the current program against its defined objectives, and in the context of the requirements of a broader technology-based economic development (TBED) strategy. Using the insights and specific issues provided by this review, a survey of Center Directors, interviews with key stakeholders, and using best practices gleaned from around the country, we provide recommendations for near-term and future consideration by the North Dakota legislature, Department of Commerce, and Centers of Excellence Commission. We were not tasked to evaluate individual centers or to conduct a financial audit.

The Centers of Excellence program was introduced as a core element of the State's technology-based economic development strategy following a pilot launch in 2003. In a very short period of time, the North Dakota Centers of Excellence program has made remarkable progress. Although the program is still in its adolescence, program objectives have been refined, the proposal process improved, and management and oversight weaknesses corrected. With this strong platform as a base, it is time to look ahead and reassess the long-term objectives for the program, establish "stretch goals," and make appropriate investments to strengthen the state's longer term economic future.

Herein we provide our overall assessment of the status of the COE program, a discussion of how North Dakota is faring in terms of transitioning towards "New Economy" sources of growth and diversification, and an identification of key issues and challenges for the COE program that TPMA believes deserve legislative or administrative attention. For each of the key issues and challenges identified, we provide an assessment, a discussion of options based on best practices, and our recommendations either for a preferred option or for the decisions required before preferred options can be selected.

We also provide recommendations concerning "new directions" that TPMA views as important for North Dakota to consider based on best practices and the operations of successful comparator programs nationwide.

We believe we have identified those changes and new directions for the COE program that appear to offer the greatest potential for building on past success to diversify the North Dakota economy, and enhance the Research and Development (R&D) / commercialization infrastructure in the State's priority economic clusters.

Summary of Recommendations

Recommendation 1.0 – Pursue a Focused Technology-Based Economic Development (TBED) Strategy

We recommend that North Dakota pursue a very focused technology-based economic development strategy (TBED) investment program targeted on leveraging and building state assets, much like Texas did with oil revenues following the oil-shocks of the 1970's and 1980's. To a certain extent, this recommendation is embedded in Goal 3 of the State's new economic development plan, and is being incorporated into the plan for the State Board of Higher Education. We are suggesting that North Dakota leadership adopt an expanded range of strategic TBED objectives.

Recommendation 2.0 – Build and Assign a Metrics Working Group to Report New Performance Measurements for the COE Program that Align with State Level TBED Metrics

2.1 – Gather and assign a small working group to build up a candidate set of linked performance measures that best fit State TBED needs and for reporting on the COE program. Some of the metrics discussed in this report are candidates for monitoring both state TBED progress and COE performance.

2.2 – Include reporting “average leverage” ratios to track total and industry investment leveraged by the state investment as core performance metrics for the COE program. North Dakota captures the basic data already, but the reporting does not focus on explaining the critical nature of “leverage” for achieving longer-term economic development objectives. Carefully documenting federal and private “leverage” trends is one of the better tools for tracking the value of state COE investments. It is among the best return on investment (ROI) metrics used by similar programs across the nation.

Recommendation 3.0 – Educate, Train and Provide Services in Intellectual Property (IP) Practices and Technology Transfer

Prepare specific materials providing detailed guidance about rules and procedures for IP management and technology transfer targeted to the COE programs and their industry partners in an effort to alleviate confusion and uncertainty. Standard contractual language should be made available that can be tailored to each COE and COE-related project reflecting partner objectives, state and institution management policies regarding IP, and the relevance of the Bayh-Dole Act assignment of IP ownership rights (see Recommendation 4.0).

Recommendation 4.0 – Monitor Federal Funding

Each university and COE should create a very transparent system to track and report applicable federal funding that would trigger the Bayh-Dole Act provisions for specific COE projects and proposals (provisions that under certain conditions would assign all project IP as university property regardless of the private sector contribution). Absent clarity, experienced firms will generally assume Bayh-Dole is in play, and may limit COE participation in the development of core technology, while inexperienced firms can end up in serious IP ownership disputes.

Recommendation 5.0 – Adopt a more integrated statewide technology management program

Adopt a more integrated statewide technology management program that can serve all campuses and COEs.

Recommendation 6.0 – Develop a COE-based “Proof-of-Concept” Program

Create a “proof-of-concept” fund within the COE program to help tease out commercial ideas that otherwise might be left on the table. It should have easy access--open submission or perhaps a quarterly cycle. This would open the program to earlier stage opportunities and perhaps induce smaller companies to participate. Key success factors for a proof of concept program must include:

- Provide small amounts of flexible funding to conduct testing, to validate the technology, and to determine whether it meets a market need at a competitive price.
- Connect university inventors with entrepreneurs, investors, and commercial partners.
- Encourage interactions between university researchers and industry to help identify commercially relevant research questions; ensure that researchers are aware of both developments in the marketplace and the technological challenges facing specific industries of special interest to North Dakota.

Recommendation 7.0 – Add Independent Peer Review to the COE Proposal Process

Adding an independent peer review to the COE proposal process will be critical as the COE program moves forward. It is highly likely that future proposals will require increasingly technical review and more sophisticated evaluation of commercialization potential. We believe this will: 1) help to pre-empt potential future political challenges; 2) bring external feedback that can be used to significantly improve center operations and future proposals; and 3) expose North Dakota R&D and commercialization programs to a cadre of national experts. Peer review could be scheduled immediately following the Department of Commerce review phase.

Recommendation 8.0 – Reassess Matching Requirements

8.1 – Leadership should consider reassessing the 2:1 match requirement, either across the board, or specifically for smaller firms.

8.2 – Provide clear guidance on permitted in-kind match.

Recommendation 9.0 – Allow for Modest Overhead

Permit a modest overhead charge to universities on state provided COE funds (on the order of 5%-10%), since it is clear that some new costs are imposed by the COE program.

Recommendation 10.0 – Review Reporting Requirements

Center directors clearly view the reporting requirements as onerous and time consuming. They also report that the data the state wants them to collect from their private partners is part of the problem. Firms do not want to disclose detailed employment and wage data for competitive reasons. Discussions

with university leadership about reporting requirements suggest that Center directors may not be the best point for the reporting tasks. We see several lines of attack to help deal with this challenge.

10.1 – The Centers of Excellence Commission and the Department of Commerce should convene a working group of COE private sector partners and potential partners to explicitly discuss their perceptions of the COE program and its policies and procedures. This would build upon the survey of private participants conducted during the spring of 2010. Specifically it should seek their input on the best ways to collect the jobs and wage (and other) data that the State needs to report progress.

10.2 – Guidance documentation needs to be developed regarding reporting policies and procedures that become part of any contractual negotiation between a COE and a private party.

10.3 – These policies and procedures need to be built into the newly launched training program for COE directors and staff.

10.4 – Reduce part of the reporting burden by addressing additional streamlining, record consolidation and standardization procedures through the creation of an intranet site and adoption of tracking software. Documents and regular financial reports could be posted to the site upon their receipt so that an electronic file is easily and remotely available to Department of Commerce staff and Commission members. Among others, Indiana's 21st Century Research and Technology Fund uses such a secure reporting vehicle.

Recommendation 11.0 – Create a Targeted Eminent Scholar Program

North Dakota should give strong consideration to funding a complementary Eminent Scholar program specifically focused on priority industry sectors, tied to existing COEs, and linked to industrial experience and/or a commercialization track record. Such a program cannot be tied to competitive bidding rounds. It needs to be a flexible fund that can be called upon in response to emergent opportunities in a targeted recruiting strategy. Criteria must be flexible, but with very high minimum standards.

Recommendation 12.0 – Create a Small Business Focused Grant Program

As discussed in the body of the report, the COE program contains elements that tend to create barriers to smaller firms. From the perspective of the state's development strategy, there is high value in engaging young, smaller firms in the COE program. Along with the proof-of-concept program noted above (Recommendation 6.0), which is not specifically small business focused, TPMA recommends creating a small business focused grant program that:

- Reduces match requirements for smaller firms on existing grants.
- Offers a separate competitive grant fund for the COE to engage smaller firms.
- Provides matching grants to firms that have won a competitive Federal SBIR grant. The purpose of such a match is to support movement along the commercialization pathway.

Recommendation 13.0 – Create a Federal Funding Match Initiative

We recommend that North Dakota create or reserve a portion of future COE funding for a state priority COE matching fund. This fund would be available to help provide local match to university centers which are seeking high value federal (and perhaps foundation funded) projects that meet the highest priority state economic development objectives. Criteria for award would have to be very clear. Among others, a state match must be critical to the prospects for success, and other university and private stakeholders must be willing to make a significant contribution as well.

Recommendation 14.0 – Strengthen Collaboration and Build Commercialization and Entrepreneurial Networks

Bridging the chasm between academia and industry ultimately requires the development of strong networks among academia, the COE program, private firms, and external sources of R&D funding and capital. Also critical is development of a deep culture of collaboration among researchers, COEs universities, and other outside partners. In a state as small as North Dakota, cross-COE, cross-institution, and academic/industry collaboration is extremely valuable in building a critical mass of talent in targeted clusters.

14.1 – We recommend that the Department of Commerce, working with the COE Commission, be assigned the responsibility to begin building a networking program around the state focused on linking COEs with firms in target clusters and key external sources of R&D, commercialization, and entrepreneurial funding and support.

14.2 – We recommend that strong incentives be placed in funding programs to encourage greater cross-COE, cross-institution, and academic/industry collaboration.

Introduction

Historically, the economies of states in the Great Plains depended on natural resources and agriculture, and relied on low costs rather than innovation, or a knowledge-based economy to support economic growth. Agriculture and energy remain critical state assets, but increasingly North Dakota's economy is transforming into one driven by technology. The Kauffmann Foundation refers to this transition as the "New Economy," but whatever it is called, 21st century economic progress will be based upon firms that constantly innovate and maximize the use of technology in the workplace as they compete to excel or even survive in today's global economy.

The term most commonly applied to discussions of strategy and policy to succeed in this new economy is Technology Based Economic Development (TBED).¹ Successful economic development strategy, planning, and implementation increasingly must balance traditional approaches with TBED.

Our Task

Stakeholders in North Dakota are embracing elements of a state-wide technology based economic development (TBED) strategy focused on leveraging universities and private sector businesses through a "Centers of Excellence" program. Created in 2005, the Centers of Excellence program is North Dakota's centerpiece of a growing technology-based economic development strategy. The North Dakota Department of Commerce and the Centers of Excellence Commission retained Thomas P. Miller and Associates (TPMA) to conduct a best practice review of North Dakota's Centers of Excellence program. Our task was to: 1) analyze the current Centers of Excellence program; 2) compare North Dakota's program to similar initiatives in other states; and 3) offer recommendations for taking the COE program to the next level.

Elements of a tech-based economy:

- An intellectual infrastructure, i.e. universities and public or private research laboratories that generate new knowledge and discoveries
- Mechanisms for transferring knowledge from one individual to another or from one company to another
- Physical infrastructure that includes high quality telecommunications systems and affordable high speed Internet connections
- Highly skilled technical workforce
- Sources of risk capital
- Quality of life, and
- Entrepreneurial culture

Source: SSTI

¹The State Science Technology Institute (SSTI) is the leading national organization focused on state-level TBED strategies and policies. A foundational SSTI document that helped to frame our thinking and analysis throughout this project and one highly recommended for reference is: State Science and Technology Institute, *A Resource Guide for Technology-based Economic Development*, Prepared for the Economic Development Administration, U.S. Department of Commerce, August 2006.

Centers of Excellence in a TBED Strategy

Nationally, COE programs are one of the many important elements of a successful TBED strategy. A Milken Institute study found that university research centers and institutes are “undisputedly the most important factor in incubating high-tech industries.”² While research centers can be extremely important in generating new discoveries, in order to leverage their true potential as contributors in developing a state’s technology-based economy, there must be mechanisms in place to move that innovation into the marketplace.

In a state or region that is seeking to grow its research base, creating a center of excellence can help to attract faculty and increased federal and private R&D funding, but it should be recognized that growing the research enterprise will not necessarily, in and of itself, lead to economic benefit. Capitalizing on the research base requires that attention be paid to commercializing research findings as well.

Source: SSTI

States that led the early TBED movement used research centers, often called “Centers of Excellence” as a cornerstone to their overall TBED strategy. The Centers of Excellence concept has been tailored to meet the unique needs of different states, and also has evolved with the growth of understanding about effectiveness among universities, industry and government leaders. Today, COEs are organized in several different ways and success is based on each center’s ability to “bridge the gap between two very different cultures—academia and business.”³

Commercialization is that bridge. It is often said that federal funding for science and engineering is the process to convert money into knowledge, and that commercialization is the process to convert that knowledge into money. However, many significant barriers exist that can impede commercialization, limit the ability to capture the full economic potential of innovation, and negatively affect strategies that states have built around investing in their respective research and development (R&D) enterprises.

Our Methodology

The purpose of this study is to make recommendations for improvement to the Centers of Excellence program based on legislative intent and the best practices used by other states that have implemented similar TBED strategies.

This is not an evaluation of individual centers or a financial audit. This study also does not specifically estimate the economic impact and accomplishments of the COE program as an economic development initiative within the State of North Dakota. The Department of Commerce has processes in place to accomplish these tasks. TPMA reviewed the COE reports, financial audits, and the economic impact

² Milken Institute, State Technology and Science Index: Enduring Lessons for the Intangible Economy, by Ross DeVol and Anita Charuworn with Soojung Kim, June 19, 2008.

³ SSTI, supra note 1 at p. 14

study as input for the analysis in order to compare national best practices to North Dakota processes, structure, performance, accomplishments, or impacts on economic development. This review and assessment in no way reflects a financial audit of record.

TPMA issued a survey of Center directors addressing a wide range of operational and strategic issues. Some of those findings are explicitly referenced herein. We greatly appreciate the time and effort the center directors devoted to responding. The survey results are available in a separately bound volume.

Using the survey results and our benchmarking and best practices research, TPMA engaged in a series of stakeholder interviews across the state, to seek out divergent interests, solicit insight, test ideas and determine the menu of most important issues upon which to focus our final analysis.

The focus was to obtain information and insights on the COE program against its defined objectives, and in the context of the requirements of a broader TBED strategy. Using the insights and specific issues provided by this review and best practices gleaned from around the country, there are recommendations defined for near-term and future consideration by the Legislative Interim Workforce Committee, the North Dakota Legislature, the Centers of Excellence Commission and the Department of Commerce.

Organization

This report is a holistic assessment of the COE program as an economic development initiative, and is designed to capture progress as envisioned in its initializing statute. The evaluation process reported herein is designed as one input to the complex, interactive process that is government decision-making. The focus is on providing information and options that can assist decision-making regarding resource allocation and program improvement, while assuring overall transparency and accountability.

The report is organized into four sections. Section I provides: 1) our overall assessment of the status of the COE program; 2) a discussion of how North Dakota is faring in terms of transitioning towards “New Economy” sources of growth and diversification; and 3) an identification of key issues and challenges for the COE program that TPMA believes deserve legislative or administrative attention.

For each of the key issues and challenges identified, Section II provide(s) an assessment, a discussion of options based on best practices, and our recommendations either for a preferred option or for the decisions that need to be made before preferred options can be selected.

Section III identifies “new directions” that are important for the state to consider based on best practices and successful programs that could take the COE program to the next level.

Section IV provides a summary of the key conclusions and recommendations.

Section I: State of the Centers of Excellence Program Today

Program History

In 2002, North Dakota's federal representatives, state, regional and university leaders began making efforts to stimulate elements of a high-tech economy, including the creation of the Red River Valley Research Corridor and the annual Upper Great Plains Technology Conference. These initiatives as well as other development plans in several key industries focused on the goal of attracting new companies and high-paying jobs to the state by maximizing the world-class research underway at the state's universities.

By 2003, North Dakota's Governor was calling for budget proposals to combine economic growth and education. During the 2003 legislative session, the North Dakota Legislature, acting on the Governor's proposal, created "Centers of Excellence" within North Dakota's University System (NDUS).

North Dakota legislators funded several pilot Centers of Excellence projects in the 2003 session before launching the full program. These include the University of North Dakota (UND) Center for Innovation in Grand Forks, the NDSU Technology Incubator and the North Dakota State University (NDSU) Beef Systems Center of Excellence in Fargo. In 2005, the Legislature created the current competitive grant program.

Since then, as one of few states to experience a budget surplus, the North Dakota Legislature has approved a total of \$62.3 million for the program. Of these funds, as of June 30, 2009, the Centers of Excellence Commission has awarded \$42.3 million (spent, disbursed but not spent, and awarded awaiting disbursement), launching 18 new Centers of Excellence. During the 2009 legislative session, a Centers of Excellence Enhancement Grant program was created, making \$10 million in COE funds available to the state's research universities during 2009-2011. As of June 30, 2009, approximately \$19.9 million, or about one-third of the total, was spent by the centers.⁴

Since its founding, several key changes have been made to the program:

- In 2007, proposed centers whose primary mission was built around workforce training were removed from eligibility for program funding. Key objectives and metrics are significantly different from the core legislative intent for the COE program. It was determined that education and workforce centers should be treated separately, and the legislature created a separate Workforce Enhancement Grant program to address the needs of workforce training centers.
- In 2007, the Department of Commerce was given the task of supporting the COE Commission's activities and oversight functions.

⁴ Data are from *Centers of Excellence Annual Report 2009*, p.3. Since June 30, 2009, additional awards have been approved and Centers have continued to expend against disbursements.

- As of 2008, award funds were shifted from disbursement at launch, to staged disbursement aligned with progress.
- Also in 2009, a performance audit of the program was conducted. The Department of Commerce has implemented all 15 of the recommendations contained in the audit.

Compared to other state TBED initiatives across the U.S, North Dakota's program is still quite young and working its way up the "learning phase." Even at this early stage, the COE program has had a significant economic impact. As reported in the most recent annual report from June 30, 2009, \$19.9 million of the awarded funds have been spent by the centers, which have leveraged over \$130 million from the private sector and other sources (Table 1).⁵

Table 1: North Dakota Centers of Excellence Performance Metrics

Economic Benefits of COE Program	Statistic
Funding	\$19.9 million
Economic Impact	\$329.4 million estimated total economic impact \$115.5 million direct impact
Jobs Creation	2,060 total created jobs 922 direct jobs with an est. \$44.5 million payroll
Private Sector Partners	135 companies have formed partnerships
New Businesses	17 new or expanded businesses

Observations

For this assessment, it was very important to recognize that this program and the centers that it supports are truly in very early development. As of June 30, 2009:

- 7 centers had been in operation for less than 1 fiscal year
- 3 centers had been in operation for 2 fiscal years
- 9 centers had been in operation for 3 fiscal years
- 1 center had been in operation for 4 fiscal years

As with any program of this nature, the "learning phase" can provide significant opportunities for improvement. Indeed, we are already seeing improvements being implemented in accountability, transparency and program focus following the 2007 and 2009 legislative sessions and in response to the

⁵Updated estimates for January 1, 2007 – June 30, 2009, based on F. Larry Leistritz, Dean A. Bangsund, and Nancy M. Hodur, *Economic Impact of North Dakota Centers of Excellence Program, 2007*, reported on pp. 3-4 and in Appendix A, *Centers of Excellence Annual Report 2009*, pp. 29-31.

2009 State Audit of Department of Commerce programs.⁶ As key stakeholders prepare for the 2011 legislative session, it is time to review all the issues that have emerged in terms of: 1) operations of the current program; 2) the specific objectives of the COE program; and 3) how the COE program might evolve or be enhanced as a central element of the state's TBED strategy. Each of these dimensions will be important as leaders wrestle with concerns about measuring progress, return on investment, public investment decisions, program operational issues, and the long-term economic vitality of the state. In post "Great Recession" times, corporate and public decisions will fall under far greater scrutiny. Transparency, documented performance and ROI will be key elements of what is becoming to be known as "The New Normal." The Centers of Excellence program is no exception and commitment to these values must guide its stakeholders into the future.

Mission Evolution

By statute, the North Dakota Centers of Excellence program has three core missions: 1) economic development, 2) research and development, and 3) commercialization, as defined in the original legislation:⁷

1. Use university or college research to promote private sector job growth and expansion of knowledge-based industries or use university or college research to promote the development of new products, high-tech companies, or skilled jobs in this state.
2. Create high-value private sector employment opportunities in this state.
3. Provide for public-private sector involvement and partnerships.
4. Increase research and development activities that may involve federal funding from the National Science Foundation experimental program to stimulate competitive research.
5. Foster and practice entrepreneurship.
6. Promote the commercialization of new products and services in industry clusters.
7. Leverage other funding, including cash from the private sector.
8. Become financially self-sustaining.
9. Establish and meet a deadline for acquiring and expending all public and private funds specified in the application.

The Centers of Excellence Commission added two additional criteria for COE applications:

1. Community support; and
2. Collaboration among institutions.

⁶ Office of the North Dakota State Auditor, *PERFORMANCE AUDIT REPORT*, Department of Commerce, Report No. 3027, August 11, 2009.

⁷ 15-69-04. (Effective through July 31, 2011) Application - Eligibility requirements.

While each component listed is important on its own merits, when combined, the mission became somewhat amorphous in implementation. As noted above, centers focused primarily on education and training are excluded from eligibility and have been given a separate funding stream. Although centers focused on entrepreneurship have not been explicitly excluded from eligibility, a new fund was created to support these activities. These changes now permit a sharpening of program focus. Essentially COEs now have two core missions, attracting private and federal funding to become self-sustaining and commercialization.

This will be discussed in more detail below, but clarity in mission is critical to developing detailed program objectives, desired outcomes, and metrics. Our research has clearly revealed that program objectives, outcomes, and metrics are all issues that require some attention in efforts to improve the COE program.

Making Progress: North Dakota's TBED Metrics

In the "New Economy", winners and losers, in terms of geographic locations, will be defined in part based upon their abilities to support the development of technology-based companies. In order to nurture and sustain the development of new technology, state leaders need to know how their state is progressing in key indicator areas and how it stacks up with peer competitors.

However, the tools we use today to measure the "New Economy" are severely outdated. Many credible reports and, in turn, many states, only measure state economic performance or state economic policies. It is relatively common to cite data collected on state economic performance (e.g., jobs, firms created, incomes, etc.), but there is very little data available to measure a state's true economic structure. Decisions about which metrics the state determines are most important and wishes to target as part of its economic development strategy should frame how the COE program evolves and is measured.

There are several ways state leaders can determine progress. This is particularly true when it comes to different science and technology measurements. The *Milken Institute 2008 State Technology and Science Index* and the *Kauffman Foundation 2008 State New Economy Index* have become widely respected, and based upon TPMA's experience, we believe that they are among the most comprehensive economic structure measurement tools available today. Both are periodically compiled and updated to gauge how each state is faring in technology-based economic development (TBED). They provide excellent starting points for positioning North Dakota's strategic economic goals and COE's contribution to achieving them.

Milken Institute 2008 Index:

<http://www.milkeninstitute.org/tech/tech.taf>

Kauffman Foundation 2008 Index:

http://www.kauffman.org/uploadedfiles/2008_state_new_economy_index_120908.pdf

North Dakota's Position in Technology and Science (Milken Institute)

The Milken Institute's 2008 State Technology and Science Index takes inventory of the technology and science assets that can be leveraged to promote economic development in each state. Combining dozens of indicators, such as R&D investment, risk capital, educational achievement, and the presence of skilled workers, it offers a sophisticated means for benchmarking. It looks at 77 unique indicators that are categorized into five major components, which together, paint a revealing picture of North Dakota's comparative strengths and weaknesses:

- Research and Development Inputs
- Human Capital Investment
- Risk Capital and Entrepreneurial Infrastructure
- Technology and Science Work Force
- Technology Concentration and Dynamism

North Dakota has been recognized in the *Index* as the "Most Improved" state overall. According to the report, North Dakota showed the strongest improvement, moving up fourteen positions to 31st place. In fact, North Dakota has risen in every category that the Milken Institute measures to determine potential growth based on a TBED strategy (Table 2).

Most notably, North Dakota's federal, university and private sector research and development efforts, referred to by the Milken report as **Research and Development Inputs**, were recognized as the "Most Improved" state, ranking 19th nationally. The COE program was a key part of this improvement.

However, North Dakota's 46th-place national ranking in the **Risk Capital and Entrepreneurial Infrastructure** composite is of particular concern even though the state advanced four positions from 50th-place, improving in the number of business incubators as well as business starts.

Table 2: North Dakota's Position in Technology and Science

Technology & Science Assets	Rank		
	2008	2004	2002
North Dakota's Overall Ranking	31	45	45
Research and Development Inputs	19	40	40
Human Capital Investment	22	27	28
Risk Capital and Entrepreneurial Infrastructure	46	50	50
Technology and Science Work Force	33	35	44
Technology Concentration and Dynamism	35	48	48

North Dakota's New Economy Rankings (Kauffman Foundation)

The Kauffman Foundation 2008 State New Economy Index focuses more narrowly on one simple question: To what degree does the structure of state economies match the ideal structure of the New Economy?

Overall, the report uses twenty-nine indicators, divided into five categories that best capture what is new about the New Economy (Table 3):

1) **Knowledge jobs** – Indicators measure employment of IT professionals outside the IT industry; jobs held by managers, professionals, and technicians; the educational attainment of the entire workforce; immigration of knowledge workers; migration of domestic knowledge workers; employment in high value-added manufacturing sectors; and employment in high-wage traded services.

- North Dakota – Top Five in highest educated foreign immigrants with 14.20 average years of education and ranks 1st nationally

2) **Globalization** – Indicators measure the export orientation of manufacturing and services, and foreign direct investment.

- North Dakota - Top Five Mover in value of exports per manufacturing and service worker to 14th nationally

3) **Economic dynamism** – Indicators measure the number of fast-growing “gazelle” companies; the degree of job churning (which is a product of new business startups and existing business failures); the number of Deloitte Technology Fast 500 and Inc. 500 firms, the number and value of initial public stock offerings (IPOs) by companies; the number of entrepreneurs starting new businesses; and the number of individual inventor patents issued.

- North Dakota – Top Five Mover in fastest growing firms to 33rd nationally
- North Dakota – Top Five Mover in initial public offerings to 17th nationally

4) **Transformation to a digital economy** – Indicators measure the percentage of population online; the number of Internet domain name registrations; technology in schools; the degree to which state and local governments use information technologies to deliver services; use of IT in the health care sector; Internet and computer use by farmers; residential and business access to broadband telecommunications; and use of information technology in the health care system.

5) **Technological innovation capacity** – Indicators measure the number of jobs in technology-producing industries; the number of scientists and engineers in the workforce; the number of patents issued; industry investment in research and development; non-industry R&D; venture capital activity; and movement toward a green energy economy.

We recommend that North Dakota should pursue a very focused TBED investment program targeted on leveraging and building state assets, much like Texas did with oil revenues following the oil-shocks of the 1970’s and 1980’s. The state is starting from a relatively low base relative to the

Recommendation 1.0

Pursue a Focused TBED

Strategy: Recognizing that North Dakota has taken the first steps toward a technology-based economy, we recommend that state leadership adopt an expanded range of strategic TBED objectives.

rest of the nation, but with a good business environment as a foundation and among the strongest state fiscal positions, North Dakota is in a strong position to significantly gain on competitors and peers. Both the Milken and Kauffman systems of measurement show important gains in recent years that can be built upon. North Dakota has strong traditional assets to leverage in pursuit of a more aggressive TBED strategy. It is home to significant academic assets, two research universities with growing portfolios and R&D concentrations (University of North Dakota and North Dakota State University), a network of other strong post-secondary institutions, and a maturing high-tech industry. The state has invested in developing lead organizations and select programs and incentives upon which the state can build, including: the North Dakota Economic Development Foundation, Innovate ND, incentives for angel investors, R&D tax credits, and of course the COE program.

Table 3: Kauffman Foundation 2008 New Economy Rankings

New Economy Rank by State	Overall	Knowledge Jobs	Globalization	Economic Dynamism	Digital Economy	Innovation Capacity
Maryland	3	4	24	9	8	5
Utah	12	16	32	1	12	20
Minnesota	14	8	33	13	29	17
Texas	18	32	2	21	20	24
Kansas	31	24	36	33	21	27
Indiana	36	38	25	41	36	31
North Dakota	39	34	34	34	39	39

Key Issues and Challenges

Our review of the COE program in the context of legislative intent and a broader vision of a state TBED strategy has identified an array of key issues and challenges that we will focus on in the rest of this report. These issues and challenges fall into three overlapping and interdependent categories:

1. The specific roles, missions and objectives for the COE program (especially in context of the state's TBED strategy).
2. Operational and effectiveness improvements.
3. COE program modifications and new directions.

Within these overarching categories, some of the key issues and challenges that we will address below include:

- Limited awareness about the importance of technology-based economic development for North Dakota.
- Building mission clarity: Variance exists among participants and stakeholders concerning the COE program's mission and objectives.

- Aligning metrics with objectives: Reporting requirements not entirely consistent or aligned with indicators that would best gauge performance.
 - COE return on investment not well understood.
- Clarifying certain intellectual property management and technology transfer policies. These are key to an effective long-term commercialization strategy.
- Addressing several accountability, transparency and other administrative issues that could be improved.
- Barriers to small company participation.
- Enhancing formal and informal networking, peer interaction and collaboration among COEs, their affiliates and partners, and other key stakeholders in the technology-based economic development (TBED) community.
- Attracting world-class research faculty and building world-class R&D facilities in ways that strongly support the core commercialization mission for the Centers of Excellence Program.

Section II: Looking Forward

Objective Clarity

Many states have made significant investments to create university-industry research centers (COEs) focused on topics relating to the state's key industry sectors. Regardless of the specifics, all of these efforts have been aimed at achieving technology-based economic development by leveraging a state or region's university research strengths. Specific objectives and constraints drive design of any specific COE. Success, however, results when the Center is able to bridge the chasm between two very different cultures, academia and business. SSTI identifies four primary uses for COEs:

- Build a state or region's research enterprise.
- Encourage academic researchers to undertake research with potential economic benefits.
- Assist local companies by tapping university resources.
- Encourage the commercialization of university-developed discoveries.

The North Dakota statute encompasses all four. All COE programs have multiple objectives. The most successful programs tend to prioritize objectives and set metrics accordingly. It is clear that the vision and objectives among North Dakota universities and their COE directors and that of legislators and other stakeholders differ. Commercialization and economic development dominate the policy discussion, while it is only part of the priorities as seen from academia.

According to the TPMA COE director's survey results, 36.8% (seven directors) view the primary mission of their particular center as a research and development activity, 15.8% focused on Technology Commercialization and 10.5% as a Resource for Entrepreneurs (Table 4). When queried about the primary mission of the COE Program, 31.6% (six directors) of those who responded saw the Centers as an economic development tool, while another 31.6% also named focused research and development, while only 15.8% (three directors) believed it was technology commercialization (Table 5).

Table 4: Director's Survey Result

What do you view as the primary mission of your Center? (please select one)		
Answer Options	Response Percent	Response Count
Training Provider	21.1%	4
Technology Commercialization	15.8%	3
Resource for Entrepreneurs	10.5%	2
Research & Development Center	36.8%	7
Resource for Targeted Industry	0.0%	0
Other (please specify)	15.8%	3
answered question		19
skipped question		0

Table 5: Director's Survey Result

What do you view as the primary mission of the Program? (please select one)		
Answer Options	Response Percent	Response Count
Economic Development Tool	31.6%	6
Workforce Development	10.5%	2
Technology Commercialization	15.8%	3
Resource for Entrepreneurs	0.0%	0
Focused Research & Development	31.6%	6
Other (please specify)	10.5%	2
<i>answered question</i>		19
<i>skipped question</i>		0

Since one of the primary goals of North Dakota's two research universities is to grow their research base, it is not surprising that this priority cascades through the enterprise. The COE program is an excellent tool for growing research funding. It can help to attract faculty and expand federal and private R&D funding. However, growing the research enterprise will not necessarily, in and of itself, lead to economic benefit, but is a necessary condition of long term COE success.

The legislative interest in commercialization and economic development requires growing the research base in areas of high potential for the state economy and building the capacity to capitalize on that research. Building research capacity and attracting world-class researchers by themselves do not lead to the development of collaborative industrial academic partnerships. Similarly, leveraging university strengths into new technologies and companies can be quite a challenge if those strengths do not align well with the needs of regional industry and employee skills.

Looking forward, design of the COE program and associated funding initiatives need to clearly support targeted objectives. Crossing the chasm requires that a set of success criteria be fully and consistently integrated into evaluation of applications for new centers and development of grant programs for existing centers:

- Strong industry participation, by leadership, not just industry research staff.
- Continued matching requirements.
- Focus on specific areas of technology that offer potential for economic development.
- Insistence on multidisciplinary COE projects and initiatives.
- Integration of commercialization support for the researcher into center design.

Return on Investment (ROI)

TBED programs are longer-term investments in the economy's future and part of the challenge facing elected officials and their staffs is being able to articulate the value proposition in compelling ways. Many states tend to rely on traditional economic development metrics (jobs created, dollars invested,

tax base created) when they convey results to their stakeholders. These short-term metrics are incomplete measures of the true impact of TBED strategies. Now that TBED objectives are explicitly incorporated into the new state economic development plan sets as Goal 3: “Accelerate innovation and entrepreneurship in targeted industries and emerging technologies,” it is increasingly important to begin adopting a suite of more appropriate metrics for tracing state progress as well as specific program performance and return on investment (ROI).

Quantifying the impacts of TBED activities, including investments in science and in innovation generally has advanced significantly in the past few years as more associations, researchers, and agencies wrestle with the problem. Establishing an exact relationship between funding and economic activity (formation of new companies and new jobs) is difficult, but based on North Dakota’s own early indicators, the program appears to be improving the state’s economy. According to the latest Centers of Excellence Annual Report, at least 17 ongoing businesses in North Dakota trace their roots directly to technologies funded through the COE program, employing between 1,500 and 1,800 people. We discuss below an approach to building a suite of metrics for the State and for the COE program.

North Dakota Performance Measures

How do states really know they are getting a return on their investment? What additional metrics could be used to better understand the impact technology-based economic strategies like centers of excellence are having?

As presented in the 2009 *Centers of Excellence Annual Report* and the *Economic Impact of North Dakota Centers of Excellence Program 2007* report, North Dakota has measured the performance of the program largely in terms of economic impact, jobs, private sector participation, and new business creation.

While these metrics are clearly major indicators of output performance for TBED states, best practices have shown that there are other insightful measurements that North Dakota could also employ that may provide an even greater understanding of overall program performance.

Investment success for a TBED strategy can be measured in a variety of different ways. Two examples are listed in Table 6. SSTI suggests using the six basic categories shown in the first panel. Milken recommends the categories shown in the second panel. What all studies suggest is that the metrics track multiple dimensions of TBED strategy. The two lists have similar elements, but appear quite different. However, in the subcategories many of the same data are used to generate the composites. Each state needs to identify its own priorities and use metrics accordingly.

Table 6: TBED Measurement Best Practices

SSTI Metric Categories	Milken Science and Technology Categories
	Technology Concentration
Creation of viable start-up companies	
Successful company exits that return wealth to the state	
Creation and retention of jobs, in particular, knowledge jobs	Human Capital Investment
	Science and Technology Workforce
Attraction of capital	Risk Capital and Infrastructure
Increased intellectual property and research capacity	R&D Inputs
Enhanced market reputation	

At a minimum, North Dakota should establish a set of TBED categories to track statewide, as well as quantifying the contribution derived from the Centers of Excellence program. We will briefly discuss some of the more useful categories, with special attention to specific metrics that can be readily utilized for monitoring COE performance.

Linking State TBED and Centers of Excellence Performance Measures

We discussed above how North Dakota fared relative to other states on the Milken and Kauffman report cards focused on TBED performance. They are among the best of many efforts to track TBED performance. We recommend a small working group assigned two very specific tasks: 1) defining the overall suite of metrics that the State wants to use to track TBED progress (both internally and for public reporting); and 2) designing a set of COE metrics that directly or indirectly link to a subset of the broader state TBED metrics. This permits tracking the contribution of the COE program to overall state progress. We discuss herein a few obvious candidates for which both state and COE metrics can be monitored. The working group will need to review a broader set of potential candidates.

Firm growth, technology concentration and creation of viable start-up companies are primary goals of most TBED programs. At the state level, finding good, nationally comparable metrics is sometimes a challenge. The statistics for firms that experience the cycle of birth and death provide a good proxy for churn and dynamics at the state level, but do not reflect only technology-based activity. Start-ups (both new firms and establishments of existing firms) in high technology NAICS codes can be tracked, but since the definition of High Technology NAICS codes tends to be state-specific this metric lacks cross-state comparability. The Kauffman Foundation has been investing heavily in creating better data and data analysis to understand TBED. Among others, they publish an annual index of entrepreneurial activity that is reported at the state level. Concentration and growth in the numbers of firms and employees in high technology NAICS codes are powerful state metrics. To the extent that North Dakota universities report in the Association of University Technology Managers (AUTM) national data collection effort, university based start-ups can be tracked. COE related start-ups are already captured in the COE Annual Report. These firms can and should be tracked over time to measure viability.

R&D Inputs are a foundational metric for the new economy. National comparative sources for this kind of data typically lag 2-4 years, but most states can capture current data from in-state sources (primarily from tax returns and university reports). This kind of information provides a good measure of capacity and the potential base available for commercialization. Sub-metrics of importance here include academic R&D, industry R&D, federal R&D, major areas of R&D concentration, and SBIR and STTR awards. COEs and their industry partners can report their activity in alignment with these categories.⁸ Indeed, to a certain extent, they already do so, but the data need refinement and consistency. Attraction of external R&D funding from federal, foundation and private firms is a key objective of the COE program. It is important to try to capture not only direct match, but the growth in external funding that will help make the centers sustainable over the long term.⁹

Recommendation 2.0
Build and Assign a Metrics Working Group to Report New Performance Measurements for the COE Program that Align with State Level TBED Metrics: Gather and assign a small working group to build up a candidate set of linked performance measures that best fit State TBED needs and for reporting on the COE program.

Risk Capital and Infrastructure is a critical category of metrics for the commercialization focus of the North Dakota COE program. Metrics in this category include such items as utility patents awarded¹⁰, venture capital investment, SBIC funding, and IPO proceeds. Some may want to include IP licensing revenues, and wealth creating company exit activity. COEs and their private partner can track many of these metrics. Now that North Dakota's legislature has recently passed angel investment incentives, it will be even more important to track data related to angel and venture capital funding to demonstrate the return on investment of that public policy decision (when measuring angel money, it is certainly important to track the overall amount, but the number of "deals" may actually give a better picture of growth). This would be relatively easy data to collect from COE private partners and spin-out firms based on COE technology.¹¹

Workforce and Job Creation is a category that is treated very differently depending upon the objective of the metric. At the state level, it is important to track the workforce as investments, assets and outcomes. As investments, the state needs to focus on progress in skill and degree creation. As assets the state should be tracking the pool of technology skilled workers in the workforce. As outcomes, the focus should be on the change in the concentration of technology-based employment. COE and private partner reporting can only address the last of these three areas.

Average Leverage Ratio (Matching Rate)

Regardless of the specific sub-metrics selected to track the COE program, North Dakota may want to include reporting "average leverage" ratios to track total and industry investment leveraged by the state

⁸ See Appendix D for a National Science Foundation (NSF) scorecard on North Dakota.

⁹ For an aggregated table with information on the Milken Institute's rankings of North Dakota based on sub-categories under "R&D Input", see Appendix A.

¹⁰ For charts representing basic data collected for this report regarding patents, see Appendix B.

¹¹ For a chart representing basic data collected for this report regarding venture capital, see Appendix C.

investment as core performance metrics for the COE program. Leverage is defined herein as the total (or private) non-state investment in the COE program relative to the state investment in the COE program. It should be reported for annually and cumulative, with cumulative the most important indicator of long-term impact. North Dakota captures the basic data already, but the reporting does not focus on explaining the critical nature of “leverage” for achieving longer-term economic development objectives. Carefully documenting federal and private “leverage” trends is one of the better tools for tracking the value of state COE investments. It is among the best ROI metrics used by similar programs across the nation (Table 8).

Many states find the average leverage ratio a useful ROI-related benchmark. It is usually reported as a composite, but it is informative to report both industry leverage and total leverage. In North Dakota to-date, \$19.9 million of the awarded funds from the COE program have been spent which have leveraged over \$130 million from the private sector and other sources, which equals a matching rate of 6.5:1. Among the three states listed, all with much more mature programs, North Dakota’s average leverage compares favorably to Ohio (which has very large state investments), but is lower than Utah and Kansas. We recommend reporting both industry and total leverage as part of a regular scorecard.

Table 8: Average Leverage Ratio

Benchmark State	Total leverage	State investment	Matching rate
Utah (2006, cumulative)	\$407.2 million	\$47 million	8.7:1
KTEC (Kansas, 2008 only)	\$18.4	\$2.1 million	8.6:1
OTF (Ohio, 2009 cumulative)	\$3.2 billion	\$473 million	6.8:1
North Dakota (2009 cumulative)	\$130 million	\$19.9 million	6.5:1

IP Practices and Technology Transfer Policies

The COE goal of creating close partnerships among universities and private firms for stimulating commercial development gives some priority to consideration of statewide and institution specific intellectual property (IP) practices and technology transfer policies. We have seen a recent intensification of the long simmering national dialogue over how to dramatically improve the movement of discovery into commercial application, and in that context, the roles of federal and state policy and the evolving role colleges and universities.¹² We will use elements of this dialogue to help frame the

¹²For a good analysis of new roles for institutions of higher education see David F. Shaffer and David J. Wright, *A New Paradigm for Economic Development: How Higher Education Institutions Are Working to Revitalize Their Regional and State Economies*, The Nelson A. Rockefeller Institute of Government, University at Albany, State University of New York, March 2010. For a good state policy issues summary see Thom Rubel and Scott Palladino, *Nurturing Entrepreneurial Growth in State Economies*, National Governors’ Association, Center for Best Practices, 2000.

issues of greatest relevance both to the North Dakota COE program and to the broader statewide review of university IP and technology transfer that is currently underway. We will focus first on current practices and policies as they interact with the COE program and then discuss some potential new directions.

The center director surveys and interviews with key stakeholders revealed mixed comments concerning IP practices and technology transfer policies in the COE context. Some held a quite sanguine view that no serious issues existed, and that with persistence they had been able to negotiate required agreements. Others saw flaws in state and university policy and guidance that were barriers today, and would only become more serious over time. The information gathered and the issues discussed at the NDSU Research and Technology Park *Entrepreneurship Retreat* held in August of 2009, help to frame our discussion of several specific challenges facing the COE program.¹³ Two key related issues are: 1) confusion about IP management and technology transfer policies; and 2) the applicability of the provisions of the Bayh-Dole Act to specific COE programs and projects.

- **Confusion:** One key challenge is confusion about rules and procedures, within the universities, among COE staff, and by current and potential private firm partners in COE activity. The State and the universities have explicit documented policies and procedures for IP management and technology transfer (now under review), but it is clear that the guidance is not widely known or understood among the COE community. We strongly recommend:
 - Preparation of specific materials targeted to the COE programs and their industry partners, including draft contractual language.
 - These materials should serve as the basis for a training session for center directors and staff.
 - The COE Commission should include a section in future proposal guidance that requires the partners to discuss IP management plans in the proposals and for the parent university to certify that these plans comply with university and state policy and guidance.¹⁴
- **The Bayh-Dole Act:** A related concern was the impact of federal funding on the ownership of IP associated with COE programs and projects. Uncertainty about the rules and specifics concerning how the universities and COE directors managed and accounted for the use of federal research funding introduces perceived risk among private partners (current or potential) in COE programs. The Bayh-Dole Act (University and Small Business Patent Procedures Act, adopted in 1980, in 35 U.S.C. § 200-212[1], and implemented by 37

Recommendation 3.0

Educate, Train and Provide Services in Intellectual Property (IP) Practices and Technology Transfer:

Prepare specific materials providing detailed guidance about rules and procedures for IP management and technology transfer targeted to the COE programs and their industry partners in an effort to alleviate confusion and uncertainty.

¹³ NDSU Research and Technology park, *Entrepreneurship Retreat*, Vergas, MN, 2009.

¹⁴ This not to imply that negotiated agreements need to be in place prior to proposal submission. The purpose is to ensure that a process is in place and that the parties clearly understand their respective rights and obligations.

C.F.R. 401) deals with intellectual property arising from federal government-funded research.¹⁵ Among other things, it gave U.S. universities, small businesses and non-profits control over the intellectual property of their inventions and other intellectual property that resulted from such funding (a major policy change to improve technology commercialization). Any co-mingling of funds (among or between programs or projects that receive federal funds) will subject all generated IP to the federal statute, with some limited exceptions.

The definition of subject invention in the statute – “any invention” that is “conceived or first actually reduced to practice in the performance of work under a funding agreement” – the definition is so broad, and the exemptions so vague that many institutions assume that where federal funds have been used anywhere in a lab, a subject invention exists. With this assumption, all IP becomes university property.

We recommend that each university and COE create a very transparent system to track and report applicable federal funding that would trigger the Bayh-Dole Act provisions for specific COE projects and proposals (provisions that under certain conditions would assign all project IP as university property regardless of the private sector contribution). Absent clarity, experienced firms will generally assume Bayh-Dole is in play, and may limit COE participation in the development of core technology, while inexperienced firms can end up in serious IP ownership disputes.

Recommendation 4.0

Monitor Federal

Funding: Each university and COE should create a very transparent system to track and report applicable federal funding that would trigger the Bayh-Dole Act provisions for specific COE projects and proposals.

North Dakota and its research institutions are relatively inexperienced in IP management, technology transfer, and technology commercialization. While the universities are evolving IP management and technology transfer policies focused on university developed research, the commercialization focus of the COE program requires them to deal with complex arrangements that include balancing the interests associated with products and processes that incorporate university-developed, industry-developed, and co-developed IP. They must also deal with the “valley of death” that typically exists between university research results (even if patented) and validation of commercial potential. These are challenges faced to varying degrees in all states and by all colleges and universities. North Dakota should consider several initiatives that offer strong potential to significantly improve the overall effectiveness of IP management, technology transfer, and technology commercialization, with direct collateral benefit to COE program success.

Build experience, economies of scale, and depth in priority areas

Successful technology transfer is not dependent on any one factor but instead on the confluence of multiple factors inside and outside the academic institution. In summarizing the activities of institutions that have achieved an amount of success in the technology transfer process, The Innovation Associates

¹⁵ Title 37 — Patents, Trademarks, and Copyrights, "Chapter IV — Assistant Secretary for technology policy, Department of Commerce. Part 401 — Rights to inventions made by nonprofit organizations and small business firms under government grants, contracts, and cooperative agreements.

Technology Transfer and Communization Partnerships wrote, “Technology transfer and commercialization are as much an art as a science, and personal relations between technology transfer agents and faculty, corporate licensees and business and investment communities were key to successful efforts.”¹⁶ This leads to a conclusion that volume of activity is critical to building and maintaining the experience base and network of relationships required for a highly successful program.

Research and benchmarking prepared for or using the data collected by the Association of University Technology Managers (AUTM) provides useful results and observations in support of this conclusion:

1. There is a direct relation between volume research expenditures and other metrics leading to commercialization (disclosures, patent filings, patent expenditures, licensing income, new start-ups). This relationship is not surprising. However, the relationship is highly variable among schools reflecting type of research (social sciences, science, medical, agricultural, engineering, etc), funding sponsors (NIH/NSF vs. mission-oriented agencies like DoD vs. industry), and mix between basic and applied.
2. There is a direct relation between technology transfer success and resources devoted to the function, especially staffing, among comparable groups of institutions. A technology transfer office must be adequately staffed to be effective in developing relationships inside the university, in developing and maintaining relationships with external partners, in developing the domain depth in target technologies/industries, and in providing the technical, legal and other support required. Effectiveness and productivity vary considerably among institutions, but to a point economics of scale are very important.
3. Institutions with smaller research volumes do not justify large IP management and technology transfer staffs, and further do not provide the opportunity to develop the depth of expertise required in the various specialties. Even in institutions with quite large research volumes, technology management is frequently underfunded, leading to delays, poor responsiveness to faculty, restrictions on patent filings, and weak external marketing.

We recommend that North Dakota move towards a more integrated statewide program across all state institutions of higher education, to take advantage of economies of scale and existing pockets of expertise. Special attention must be given to the balance of requirements for activities that must be on-campus and those that benefit from consolidation and economies of scale. Whatever the final structure, the goal is to create a high quality, highly responsive technology management activity that can seamlessly serve all campuses and COEs statewide.

- A range of administrative, legal, finance, communication, and general marketing functions are easiest to consolidate. However, great care must be given to the process – the goal is increasing effectiveness and reducing, not increasing administrative burdens and delays.

Recommendation 5.0

Adopt a more integrated statewide technology management program:

The goal is to create a high quality, highly responsive technology management activity that can seamlessly serve all campuses and COEs statewide.

¹⁶ Innovation Associates, *Technology Transfer and Commercialization Partnerships*, October 2007. As reported in Maryland TEDCO, *Technology Transfer Performance of USM Institutions*, Appendix 9, January 2009.

- Another key opportunity is to create specialization among staff around a set of targeted critical technical/industrial areas, regardless of actual location. For example, the same team would focus on energy technologies across all universities. Team members could be co-located or dispersed, but must operate as a unit statewide.
- A third key advantage would be creation of an integrated statewide portfolio of technology that may offer greater value than an individual patent or copyright, and is certainly easier to market to potential licensees or commercialization partners. The Maryland Technology Development Corporation (TEDCO) provides one solution that might serve as a model to help support a statewide “one-stop-shop” for technology.

BEST PRACTICE

The Maryland Technology Development Corporation (TEDCO) launched a new intellectual property database in late 2007 that streamlines the search process for innovation investors:

The Web-based resource, InvenioIP (<http://www.invenioip.org/>), was developed at the University of Maryland, Baltimore, and allows free access to technologies available for commercialization from academic institutions, federal research facilities and private companies in Maryland, D.C., and Virginia. InvenioIP was designed to be a one-stop shop for those seeking progressive innovations and a valuable resource for researchers, developers and technology investors. InvenioIP provides summaries and investigator contact information for more than 2,700 technology innovations. Each summary includes a brief description, potential applications, licensing and patent information.

Source: Rachel Bernstein, “Maryland sets up online database of intellectual property,” *Washington Business Journal*, January 14, 2008.

Develop a COE based “Proof-of-Concept” program

As noted above, a dialogue is raging over how to make university-based technology transfer and commercialization more successful. Without exploring the multiple dimension of the policy debate, the essence is that the nation is not seeing enough value from public investments in R&D, and different stakeholders are offering very different solutions.¹⁷

¹⁷ The polar opposite players are the Kauffman Foundation and AUTM. Kauffman views a large share of the technology transfer operations on university campuses as a key part of the problem and want to create a more competitive system. AUTM sees the Kauffman proposals as not only fundamentally flawed, but likely to destroy critical institutional assets built up since passage of Bayh-Dole in 1980. For the Kauffman position see Robert E. Litan and Lesa Mitchell, the Kauffman Memo to the US Department of Commerce, “Accelerating the Commercialization of Government-Funded University-Based Research,” August 17, 2009; and Robert E. Litan and Lesa Mitchell, “A Faster Path from Lab to Market,” *Harvard Business Review*, January-February, 2010. For key rebuttals see, A.S. Pradhan, President AUTM, letter to the US Department of Commerce, RE: Bayh-Dole and

There is broad consensus that the nation needs to do a better job of commercializing R&D. The strategy of universities since passage of Bayh-Dole has primarily been concentration on use of their “technology transfer” offices to introduce businesses and investors to patented university research and help schools strike licensing deals. Corporate executives and investors complain that overly rigorous, or simply overwhelmed tech transfer offices take too long to negotiate licensing agreements. Further, the offices often try to sell ideas with unproven commercial relevance (the valley of death challenge noted above).

Universities have struggled to provide mechanisms that move innovation into the marketplace. This is not something that happens naturally or easily for a number of reasons.¹⁸

- University-developed technologies often require that additional work be conducted to determine whether the technology has commercial potential.
- It is difficult to find funding to advance the commercialization of technology owned by universities.
- Often, it may be necessary to surround the original discovery with additional patents and protections, and is almost never fundable through conventional, peer-reviewed federal programs.
- Even if commercial potential can be demonstrated, investors and customers are often unwilling to assume the risk that is associated with new technology.
- Small businesses, which are often the most innovative, generally lack the financial resources.
- Academic researchers often do not understand the marketplace and what commercial potential might exist for their discoveries.

Universities and state programs have been using a variety of means beyond traditional licensing to address these concerns. Funding has been provided to universities to become more directly involved in the commercialization process, often through commercialization offices or, more frequently, stand-alone commercialization centers. University commercialization programs vary in structure, services offered, and technologies targeted, but all take an active role in seeking out entrepreneurs and companies as partners and, in some cases, spinning off new companies. They provide assistance to researchers, inventors and entrepreneurs to help transform ideas or innovations into products ready for manufacture, marketing and distribution. They support patent applications, engineering and testing and development of business and marketing plans. They link entrepreneurs with sources of business and management expertise and help them access capital by linking firms with sources of risk capital, including both angel investors and venture capital funds, or by providing capital directly. In some cases they collaborate with or hand off clients to entrepreneurial centers, in others they tend to serve both functions. In some cases, they are designed to operate as commercial entities, such as IllinoisVentures.

Many of the programs noted above, such as IllinoisVentures, are most effective with mature commercialization opportunities. The challenge that many university programs face is identifying and nurturing immature concepts. Various states have introduced early-stage proof-of-concept funding into technology commercialization programs – some as formal centers, others as funding programs.

University Technology Transfer Effectiveness,” January 6, 2010.; and M.E. Coticchia, Vice President for Research and Technology management, Case Western Reserve University, letter to The Association of American Universities, “Response to HBR “Idea” of Letting Academic Researchers Choose Licensing Agents,” January 7, 2010. All of these documents can be found at [www. AUTM.net](http://www.AUTM.net).

¹⁸ SSTI, *supra* note 1 at p.24-25.

BEST PRACTICE

IllinoisVentures -- University-based seed and early-stage technology investment firm:

The University of Illinois created a wholly owned commercialization company, IllinoisVentures LLC, to work with campus technology transfer offices, faculty and outside entrepreneurs to create start-up companies to which the university can license intellectual property. It has expanded beyond that to become a premier seed and early-stage technology investment firm focused on research-derived companies in information technologies, physical sciences, life sciences and clean technology, based on work conducted at Midwest Universities and federal laboratories. IllinoisVentures has been consistently named by Entrepreneur magazine to its national list of the top 100 venture capital firms.

Source: <http://www.illinoisventures.com/>

The intent of early-stage proof-of-concept funding is to uncover commercial opportunities unforeseen by researchers untrained in examining market opportunities. The ultimate objective is to address the valley of death between science and commercial potential.

“Many of the great ideas get stuck in labs because scientists don’t have access to the kind of ecosystem” that Deshpande and other proof-of-concept centers offer, says Amy Salzhauer, a founder of Ignition Ventures, an investment firm based in Boston and New York that works with scientists to set up companies. “This is a way to better harvest those ideas.”¹⁹

In general, these programs offer small grant awards ranging from \$50,000 to \$250,000 focused on due diligence to determine whether there is any commercial value. In some cases, small additional funds may be made available to further refine the “proof of concept.” Other programs provide support to advance ideas beyond proof-of-concept thus reducing risk for investors and customers.

The Obama Administration supports the proof-of-concept approach and has announced a proposal to initiate a \$12 million experimental program next year allocated among several institutions to focus on proof-of-concept centers. Many prefer more organic processes than creation of a formal center. The University of Utah’s program has been structured as an alignment of the Technology Commercialization Office with the business school, permitting researchers to work more closely with business students and faculty. The University of Virginia hosts a series of proof of concept review sessions, where academics and investors evaluate ideas.

In Pittsburgh, one of the larger state-financed proof-of-concept programs, Innovation Works, has contributed some \$45 million over the past decade to helping the researchers from regional universities, the National Energy Technology Laboratory (NETL) and regional businesses prove out the concept and present them to investors. They report to have attracted over \$800 million in venture capital and to have generated some 3,000 local jobs over this same period.²⁰

¹⁹ Bob Tedeschi, “The Idea Generator Goes to Campus,” *The New York Times*, June 25, 2010.

²⁰ Innovation Works, 10 Year Community Report, Innovation Works is the Southwestern Pennsylvania Ben Franklin Technology Partner, an initiative of the PA Department of Community and Economic Development and is overseen by the Ben Franklin Technology Development Authority.

BEST PRACTICE“Proof-of-concept” approach as a center:

Perhaps the first proof-of-concept center, the William J. von Liebig Center, was established in 2001 at the University of California, San Diego. Another oft-noted best practice center is the Deshpande Center for Technological Innovation at M.I.T., originally founded with a private donation. While the von Liebig and the Deshpande centers are the highest-profile successes in this realm, similar entrepreneurial surges are occurring at other schools, like the University of Utah, Georgia Tech, the University of Kansas and the University of Southern California.

Source: Bob Tedeschi, “The Idea Generator Goes to Campus,” *The New York Times*, June 25, 2010.

“Proof-of-concept” approach as a fund:

1. Maryland TEDCO - The TechStart Program (TSP) provides up to \$15,000 to further evaluate the feasibility of a technology from a Maryland university or federal lab to be the basis of a startup company. Funds are to be used for tasks critical to determining the viability of a new company formed around the spin-out technology.
2. Maryland TEDCO - The University Technology Development Fund (UTDF) provides up to \$50,000 for proof-of-concept studies or patent extension research on Maryland university-owned technologies to demonstrate their ability to meet identified market needs. The objective is to make the technologies more attractive to licensees preferably based in Maryland.

Source: <http://www.marylandtedco.org/abouttedco/index.cfm>

We recommend creating a proof-of-concept fund within the COE program to help tease out commercial ideas that otherwise might be left on the table. It should have easy access--open submission or perhaps a quarterly cycle. This would open the program to earlier stage opportunities and perhaps induce smaller companies to participate. Key success factors include:

- Provide small amounts of flexible funding to conduct testing, to validate the technology and to determine whether it meets a market need at a competitive price.
- Connect university inventors with entrepreneurs, investors, and commercial partners.
- Encourage interactions between university researchers and industry to help identify commercially relevant research questions; ensure that researchers are aware of both developments in the marketplace and the technological challenges facing specific industries.

Recommendation 6.0**Develop a COE based “Proof-of-Concept”**

program: Create a “proof-of-concept” fund within the COE program to help tease out commercial ideas that otherwise might be left on the table.

Investment Decision and Oversight Processes

Responsible stewardship of state money is a charge shared by the North Dakota Department of Commerce and the Center of Excellence Commission. Defining responsible stewardship is complex, relies heavily on compliance with the statutes, and must evolve as the COE program matures and changes. In balancing a public investment portfolio, it is especially critical that the decision process be predictable, transparent and consistent throughout all program phases:

1. Initial identification of the investment opportunity.
2. Qualification of the opportunity.
3. Due diligence (technology evaluation, program compliance, independent market research and analysis, market strategy, credit checks on principals, management team background, financials).
4. Review and recommendation by the approval bodies.
5. Signing of compliance and closing documents.
6. Transfer of funds.
7. Continued progress monitoring and reporting.

After reviewing the legislative record, analyzing key documents such as the Performance Audit Report, assessing program changes since its inception and interviewing key stakeholders, it is clear that the financial assistance decision-making structures and processes instituted by the North Dakota Department of Commerce and the COE Commission comply with the statutes. Programmatic changes made in 2007 and 2009, and Department of Commerce responses to findings in the 2009 Performance Audit Report have corrected situations where actual practice had fallen short.

During our assessment of investment decision and oversight processes, several issues emerged that require discussion, either with regard to national best practices or in response to stakeholder feedback:

- The COE proposal process
 - Peer review
 - Length of the proposal review process
 - Match requirements
- Execution, monitoring and reporting
 - Limitation on overhead
 - Complexity

COE Proposal Process

Administrative changes since the Department of Commerce was assigned to support the COE have significantly improved the proposal review process. Commission members expressed strong confidence

in the consistency and integrity of the processes in place. The investment decision-making process has become more transparent and consistent over time, due to experience, improved documentation, and an atmosphere of open communications.

Center director training has been implemented and key guidance for centers and private sector partners has been or is being documented. We discuss below some areas where improved documentation and guidance is needed.

Peer Review of Proposals

Based on a national battery of interviews of center directors and program managers, SSTI identified peer review of proposals as a key best practice to ensure that the competitive process is supporting good science and provides some insulation of the selection process from politics. Some states use out-of-state reviewers, others use a mix of in-state and out-of-state reviewers, as required. For programs, such as in North Dakota, where commercialization is a top priority, review teams should include individuals with both academic and industrial experience.

This topic has received considerable discussion among Department of Commerce staff and members of the COE Commission. To date, the Commissioners have felt comfortable with the process, and have not required technical support beyond that available from the Department of Commerce. The Commission and Department of Commerce remain prepared to bring peer experts into the review process, if required.

However, as the program moves forward, it is highly likely that the proposals will require increasingly technical review and more sophisticated evaluation of commercialization potential. TPMA recommends that an independent peer review process be incorporated into future proposal rounds. We believe this will:

- 1) Help to pre-empt potential future political challenges.
- 2) Bring external feedback that can be used to significantly improve center operations and future proposals.
- 3) Expose North Dakota R&D and commercialization programs to a cadre of national experts.

Recommendation 7.0 **Add Independent Peer Review to the COE Proposal Process:**

Adding an independent peer review to the COE proposal process will be critical as the COE program moves forward. It is highly likely that future proposals will require increasingly technical review and more sophisticated evaluation of commercialization potential.

Peer review could be scheduled immediately following the Department of Commerce review phase. Without other changes, this could add time to the review process.

BEST PRACTICE

South Carolina Centers of Economic Excellence (CoEE) Program:

To receive award funding for a CoEE, the three research universities submit proposals that undergo a three-tier review process:

1. CoEE Review Board: Each proposal is subject to a technical review by scientific experts in the proposal's related field
2. CoEE Onsite Review Panel: Senior research officials from the Association of American University Institutions evaluate the proposals and visit all three South Carolina research universities to hear presentations and conduct interviews of investigators and university administration and submits final report with recommendations for award funding to CoEE Review Board.
3. CoEE Review Board: Votes on which new Centers of Economic Excellence to fund at final quarterly meeting each fiscal year.

Source: <http://www.sccoee.org/>

Ohio Third Frontier Program:

The Ohio Third Frontier Program offers a different focus in each round of its competitions. It funds Centers in one round, projects in another, infrastructure in yet another. Although the focus changes from round to round, the fundamental review model remains the same.

1. The Third Frontier Commission prepares and issues a detailed solicitation and bid package. They also prepare specific guidance for reviewers. The state commissions the National Research Council of the National Academy to recruit a balanced review committee of scientific, engineering, and business expertise.
2. Commission Staff review proposals for compliance and completeness, then forward valid proposals to the review committee.
3. The review committee holds an initial review meeting, making a preliminary down-select of teams for continued evaluation. Specific questions are provided to each team invited to interview.
4. The review committee holds a second set of one-on-one meetings with the down-selected teams, and prepares its final recommendations for potential funding.
5. The Third Frontier Commission meets to review the committee recommendations and votes on their decisions to fund.

Source: <http://thirdfrontier.com/>

Length of the Proposal Review Process

Concern has been expressed that the COE proposal process is somewhat cumbersome, while at the same time requiring internal pre-proposal down-select processes at the large universities that limit actual time available to prepare quality proposals.

Statute explicitly lays out the review and approval process for new Centers of Excellence awards consisting of five formal evaluations by different organizations:^{21 22}

- Centers of Excellence Commission (with support from the Department of Commerce)
- North Dakota Economic Development Foundation
- State Board of Higher Education
- Emergency Commission
- Legislative Budget Section Committee

Statutory Approval Requirements

15-69-02. (Effective through July 31, 2011) Centers of Excellence.

A commission funding award recommendation must be for a specified amount. Designation of a center occurs upon board, foundation, and budget section approval of a commission funding award recommendation. In considering whether to designate a center, the board, foundation, and budget section may not modify the commission recommendation. The budget section may not take action on an original commission funding award recommendation until the emergency commission reviews the commission recommendation and makes a recommendation to the budget section. Upon receipt of a commission funding award recommendation, the budget section shall approve the recommendation, reject the recommendation, or re-refer the recommendation to the commission with recommended modifications. If the commission receives a re-referred recommendation from the budget section, the commission shall determine whether to modify the recommendation or whether to retain the recommendation and provide additional information with the recommendation.

Based on the time-line for the most recent round of COE funding (Table 9), it is clear that in light of statutory requirements, the overall review process is actually very efficient. However, it also confirms that relatively little time is available to the prospective centers for detailed partner identification, negotiation and proposal development. Potential candidates feel constrained in negotiating with partners and putting detailed plans together until the internal university review and down-select process are complete, and the State Board of Higher Education has given their nod of approval. Moreover, potential private sector partners are unlikely to negotiate seriously and seek approvals in their chain of command for match until they know for sure that a proposal is being submitted.

²¹ 15-69-02. (Effective through July 31, 2011) Centers of excellence.

²² A brief description of the roles of each of these organizations is provided in Appendix E.

Without a statutory change in the number of organizations in the approval process, the best solution is for the Commission to begin the application process (even if in draft form) one to two months earlier, permitting the internal down-select and Board of Higher Education notification to occur before the official process begins.

Alternatively, the legislature could choose to remove one or more organizations from the approval process. Since both the State Board of Education and the North Dakota Economic Development Foundation have members on the Centers of Excellence Commission, and have never disagreed with a Commission recommendation, these two are candidates for removal from the approval process.

The Centers of Excellence Enhancement Grant program, established in 2009, does not follow the same complex review process. The Centers of Excellence Commission can approve awards based upon the criteria established in statute.

Table 9: SAMPLE TIME-LINE FOR CENTERS OF EXCELLENCE FUNDING²³

January 6, 2010	Application form, with any revisions, forwarded to colleges and universities
January 6 – March 12, 2010	Colleges and universities utilize their own process to determine which two proposals are submitted for consideration by the Centers of Excellence Commission. Each proposal must contain the college or university president's signature.
February 10, 2010	According to State Board of Higher Education policy 1914, colleges and universities are required to submit a brief synopsis to the Chancellor of any applications they plan to submit
March 12, 2010	Deadline for submission of proposals (to be reviewed for completeness and compliance) to be considered during the spring 2010 round of applications
March 15 – April 2, 2010	Commerce staff conducts due diligence on the applications including visiting with applicants and private sector partners when appropriate
April 5, 2010	Finalize review comments regarding completeness and compliance
April 6, 2010	Review comments forwarded to colleges and universities
April 23, 2010	Deadline for submission of final proposals to be considered during the spring 2010 round of applications
April 26, 2010	Proposals forwarded to Commission for review along with a due diligence report from the Department of Commerce
May 4, 2010	Commission conference call meeting to determine if any independent, expert reviews or additional due diligence is needed
May 10, 2010	Presentations on Centers of Excellence proposals before the Centers of Excellence Commission
May 19, 2010	Centers of Excellence Commission meeting to act on applications
May 25, 2010:	North Dakota Economic Development Foundation Board meeting to act on Commission-approved proposals. Decisions subsequently forwarded to the State Board of Higher Education (SBHE)
June 7, 2010	SBHE meeting to act on Commission-approved proposals. Decisions on proposals subsequently forwarded to the Budget Section

²³ TIME-LINE FOR SIXTH ROUND OF CENTERS OF EXCELLENCE FUNDING, January 5, 2010.

June 18, 2010	Emergency Commission meeting to review proposals and make recommendations to Budget Section
June 18, 2010	Proposals e-mailed to Budget Section
June 22, 2010	The Budget Section will meet and could approve, disapprove, or rerefer proposals which have been approved by the Commission, Foundation and SBHE
July thru September, 2010	Centers of Excellence funds could be made available to the colleges and universities

Matching Requirements

According to statute, the state's investment must be leveraged on a 2:1 basis with private sector and federal funds. This matching level and the recent strong programmatic preference toward cash rather than in-kind generated considerable discussion in our interviews and comments in our survey of center directors.

On the one hand, most similar programs nationally accept the importance of having "skin in the game" from private companies in activities with a strong commercial focus. Further, in-kind match is difficult to quantify and can be manipulated to look larger than it is. Some participants clearly felt that the high match would attract only the most commercial-ready partners and help to filter out the more speculative.

Recommendation 8.0

Reassess Matching Requirements:

Leadership should consider reassessing the 2:1 match requirement, either across the board, or specifically for smaller firms.

On the other hand, our interviews supported the commonly held perception that a high match requirement, especially in cash, is far more difficult for smaller companies to provide. How serious a problem this is remains quite anecdotal. Nationally, smaller, younger companies are the most dramatic sources of job growth.²⁴ Homegrown companies also are more likely to expand locally than large and out of state companies. In light of the priority given to job growth as a metric for COE success, the program bias towards more mature firms appears to be a disincentive for some of the greatest potential job creators.

A review of match requirement in comparable state and federal programs reveals a great deal of variation. Programs focused on more fundamental R&D have lower match requirements, often zero. Similarly, programs focused on mission critical R&D tend to have little or no match required, until the technology is nearly ready for deployment. In general, the more commercially focused the programs, the higher the match required. A 2:1 match requirement is not uncommon in more commercially focused programs. A few have even higher match targets, but a

²⁴ Tim Kane, *The Importance of Startups in Job Creation and Job Destruction*, Ewing Marion Kauffman Foundation, July 2010, finds that on average and for all but seven years between 1977 and 2005, existing firms are net job destroyers, losing 1 million jobs net combined per year. By contrast, in their first year, new firms add an average of 3 million jobs.

match requirement of 1:1 tends to be the most frequent program design. Some programs specifically call out lower match requirements for small firms and new programs.

Most programs permit in-kind contributions to satisfy matching requirements (at least in part), though the best programs provide clear guidance on acceptable in-kind match calculations (often based on federal program guidance).

We recommend that the leadership reassess the 2:1 match requirement, either across the board, or specifically for smaller firms. Further, we recommend that clear guidance be provided on permitted in-kind match.

Execution, Monitoring and Reporting

The COE program has evolved considerably in terms of overall administration, and our survey of center directors provided comments on strengths of the COE program:

- Knowledge of the Commerce staff.
- State personnel ability to answer questions.
- Ease in working with Commerce staff and Commission members.

The survey responses and our interviews revealed two specific execution, monitoring and reporting issues deserving examination:

- Based on the center directors survey, 70% feel the reporting requirements are excessively time consuming.
- Directors and university leadership made special note that the inability to recapture overhead expenses for the COE administration negatively affects their budget.

Limitation on Overhead

Universities are unable to use state COE funds to cover overhead charges. This reflects the legislative perception that these costs are already provided for in state funding for higher education and should not be paid twice. To a significant degree, this is true.

University leadership sees the COE program like any other activity, and believes it should bear a fair share of allocated overhead costs. This position also has validity. Further, there are some clear net new overhead costs caused by the programs itself (such as the new annual audit).

The debate over appropriate university overhead charges on R&D grants and contracts will not be resolved here, but it is appropriate to observe that the federal government, states and foundations have struggled with this issue for years. The outcome has been a trend towards acknowledging that some overhead is justifiable but setting caps on allowable cost. Since it is clear that the COE program imposes some new costs, we recommend that a modest overhead charge be permitted on state provided COE funds (suggested 5%-10%).

Recommendation 9.0

Allow for Modest Overhead:

Permit a modest overhead charge to universities on state provided COE funds (on the order of 5%-10%), since it is clear that some new costs are imposed by the COE program.

Reporting Requirements

Center directors clearly view the reporting requirements as onerous and time consuming. They also report that the data the state wants them to collect from their private partners is part of the problem. Firms do not want to disclose detailed employment and wage data for competitive reasons. Discussions about reporting requirements with university leadership suggest that Center directors may not be the best point for the reporting tasks. There are several opportunities to help deal with this challenge.

First, the Commission and the Department of Commerce should convene a working group of COE private sector partners and potential partners to discuss their perceptions of the COE program and its policies and procedures. This would build upon the survey conducted during the spring of 2010. Specifically it should seek their input on the best ways to collect the jobs and wage data that the State needs to report progress.

Second, the Department of Commerce and the COE Commission should develop guidance documentation regarding reporting policies and procedures that become part of any contractual negotiation between a COE and a private party.

Third, these policies and procedures need to be incorporated into the newly launched training program for COE staff.

Fourth, reduce part of the reporting burden by addressing additional streamlining, record consolidation and standardization procedures through the creation of an intranet site and adoption of tracking software. Documents and regular financial reports could be posted to the site upon their receipt so that an electronic file is easily and remotely available to Department of Commerce staff and Commission members. Among others, Indiana's 21st Century Research and Technology Fund uses such a secure reporting vehicle.

Recommendation 10.0

Review Reporting Requirements:

Center directors clearly view the reporting requirements as onerous and time consuming. They also report that the data the state wants them to collect from their private partners is part of the problem. Firms do not want to disclose detailed employment and wage data for competitive reasons. Discussions with university leadership about reporting requirements suggest that Center directors may not be the best point for the reporting tasks. We see several lines of attack to help deal with this challenge.

Section III: New Directions

Eminent Scholar

Many states and universities have targeted building their research base by investing in attracting world-class faculty, often referred to as Eminent Scholars. During the early 1980s, the University of Texas filled 32 endowed positions in engineering and the natural sciences, with an aggressive targeted recruiting program. Subsequently, Georgia and Kentucky grew their R&D bases through Eminent Scholars programs.

Recommendation 11.0

Create a targeted Eminent Scholar program:

North Dakota should give strong consideration to funding a complementary Eminent Scholar program specifically focused on priority industry sectors, tied to existing COEs, and linked to industrial experience and/or a commercialization track record.

Eminent Scholars programs provide funding for endowed chairs, i.e. a position is endowed via a significant up-front investment and the income from the endowing investment is used to pay the salary of the Eminent Scholar, as well as other associated expenses. The cost to endow a position in the 2005 time frame ranged between \$3 million and \$6 million. This would cover all or most of the incumbent's salary, some "start-up" costs to outfit a laboratory, and possibly some research assistant positions. A cluster of such appointments can help to build a regional knowledge economy in targeted clusters.

Traditionally, Eminent Scholars programs are designed to increase the R&D dollars flowing into a university or state by recruiting faculty with an excellent record of accomplishment in securing R&D awards. As such, it has been very attractive to university programs and states with weaker R&D bases. Eminent Scholars do not necessarily lead to direct economic benefit. Some states have explicitly targeted Eminent Scholars with a history of commercial spin-offs and technology transfer.

With the state COE program launched, North Dakota should strongly consider funding a complementary Eminent Scholar program specifically focused on priority industry sectors, tied to existing COEs, and linked to industrial experience and/or a commercialization record of accomplishment. Such a program cannot be tied to competitive bidding rounds. It needs to be a flexible fund that can be called upon in response to emergent opportunities in a targeted recruiting strategy. Criteria must be flexible, but with very high minimum standards.

The Georgia Research Alliance's (GRA) Eminent Scholars program is considered one of the best in the nation. Their selection criteria present a good starting point for discussion:²⁵

- Eligible at the rank of professor.

²⁵ SSTI, supra note 1 at p. 19-20.

- Grant productivity – faculty recruited as eminent scholars should be expected to generate \$1 million or more in R&D awards over a couple of years or be able to bring in a major grant for a center or other major effort.
- Well respected in their field and broadly cited in the literature over a sustained period.
- Working in a field in which there is general consensus that the field will be strong for the next several years.
- Demonstrate potential for developing a large-scale, comprehensive, well-funded interdisciplinary center.
- Have a track record of building teams and mentoring others rather than acting primarily in the capacity of an individual investigator.
- Exhibit characteristics that suggest they can interact at a high level with not only academics but with industry and government as well.
- Have an interest in entrepreneurship, which can mean being entrepreneurial in terms of creating his or her own company or willing to work with entrepreneurs or companies interested in commercializing a new technology or discovery.

BEST PRACTICE

Kentucky

“In Kentucky, the first \$20 million appropriation to the state’s Research Challenge Trust Fund, also known as Bucks for Brains, was used to purchase research equipment. It was only after this investment that a second appropriation of \$110 million was used to recruit faculty.”

Source: SSTI, supra note 1 at p. 20

Georgia

“With the early support of then Gov. Zell Miller and the state legislature, GRA secured a state commitment of \$750,000 to match \$750,000 put up by one of the universities to sponsor each “eminent scholar” recruited. The \$1.5 million total endowment is used as the scholar sees fit to support the research. The university in question is responsible for the salaries of the scholar and others involved in the particular project. Because one of the critical recruitment incentives for such scholars is the availability of laboratory equipment, GRA helps fund that, too. It helps match grants, primarily federal, that fund laboratory equipment needed for specific funded projects. It also helps plan, finance, and incubate high-tech startup firms derived from university research.”

Source: David F. Shaffer and David J. Wright, *A New Paradigm for Economic Development: How Higher Education Institutions are Working to Revitalize Their Regional and State Economies*, The Nelson A. Rockefeller Institute of Government, University at Albany, State University of New York, March 2010, p. 15.

A critical aspect of Eminent Scholar recruitment is willingness and ability to fund the necessary research infrastructure – labs, equipment, and related facilities for associated research team members. Infrastructure funding must be offered with the endowed chair in order to attract an eminent scholar. Georgia’s GRA frequently uses their Centers of Research Excellence program to help ensure that the centers have sophisticated infrastructure to support both fundamental and translational research required to attract Eminent scholars. GRA’s investments frequently take the form of matching funds to attract large federal and private research funding.²⁶

An Eminent Scholar program can effectively build a university’s research portfolio, and, if part of the selection criteria, build both target cluster depth and entrepreneurial activity. An alternative argument is that for similar investment, one might recruit several high quality junior faculty who might be future eminent scholars. We believe that the best strategy is a mix. Target a few superstars and build a team around them.

Small Business Grant Program

As discussed above, the 2:1 match requirement combined with a strong bias towards cash and certain other program elements tends to create barriers to COE participation by smaller firms. It also concentrates on more mature projects and reduces risk of the overall program.

From an economic development strategy perspective, young smaller firms are more likely to have a greater impact on high-wage job growth than do larger out-of-state firms. As such, TPMA recommends consideration of either a lower set of match requirements for smaller firms or a separate competitive grant program for the COE to engage smaller firms.

An approach that has proven useful in other states is an SBIR match program. These come in several flavors, but the most common is a Phase I match designed to help fund the gap between a Phase I and Phase II award. Another variant is a partial Phase II grant focused on commercialization of the Phase II results. Both rely on the federal agency review process to validate to quality of the proposal. The state role is monitoring the proposed use of funds.

Federal Funding Match

A great deal of attention has been paid to the need for match to receive state funds, but the reverse is also true. Federal agencies increasingly expect recipients to have a financial commitment as well. Universities are expected to have or build research infrastructure and provide or find private sources of cash and in-kind match as conditions for bidding on many solicitations.

Recommendation 12.0

Create a Small Business Focused Grant Program:

- That reduces match requirements for smaller firms on existing grants.
- That offers a separate competitive grant fund for the COE to engage smaller firms.
- That provides matching grants to firms that have won a competitive Federal SBIR grant. The purpose of such a match is to support movement along the commercialization pathway.

²⁶ <http://www.gra.org/ProgramsInitiatives.aspx>

Recommendation 13.0**Create a Federal Funding Match Initiative:**

This fund would be available to help provide local match to university centers which are seeking high value federal (and perhaps foundation funded) projects that meet the highest priority state economic development objectives.

We recommend that North Dakota consider creating a competitive fund that would be available to help university COEs provide partial match in pursuit of high value projects that meet state economic development objectives. As noted above this is part of the Georgia Research Alliance strategy. Criteria would have to be very clear, and the fund probably should not be permitted to provide more than a share of the match.

Strengthen Collaboration and Build Commercialization and Entrepreneurial Networks

Bridging the chasm between academia and industry ultimately require the development of strong networks among academia, COE programs private firms, and external sources of R&D funding and capital. Also critical is development of a deep culture of collaboration among researchers, COEs universities and other outside partners. In a

state as small as North Dakota, cross-COE, cross-institution, and academic/industry collaboration is extremely valuable in building a critical mass of talent in targeted clusters.

An important aspect of successful COE programs is collaboration across many dimensions. In a state as small as North Dakota, cross-COE and cross-institution collaboration is extremely valuable in building a critical mass of talent. It also improves commercialization potential. Responses to our COE directors' survey suggest significant improvement may be possible (Table 10).

Recommendation 14.0**Strengthen Collaboration and Build Commercialization and Entrepreneurial Networks:**

Build a networking program around the state focused on linking COEs with firms in target clusters and key external sources of R&D, commercialization, and entrepreneurial funding and support.

Table 10: Director's Survey Result

How would you describe your level of collaboration with other Centers and/or institutions that participate in the program in the state?		
Answer Options	Response Percent	Response Count
Excellent	10.5%	2
Good	26.3%	5
Fair	36.8%	7
Poor	26.3%	5
answered question		19
skipped question		0

We recommend that the Department of Commerce (representing the COE Commission) be assigned the responsibility to begin building a networking program around the state focused on linking centers with target clusters and key external sources of R&D, commercialization, and entrepreneurial funding.

We also recommend that strong incentives be built into funding programs to encourage greater cross-COE, cross-institution, and academic/industry collaboration. Obviously many of the centers are quite different and offer little overlap in technology or industry focus. Others may offer more potential for collaboration than anyone expects. Experience across the nation clearly reveals the value of increased collaboration.

Section IV: Recommendations

Recommendation 1.0 – Pursue a Focused Technology-Based Economic Development (TBED) Strategy

We recommend that North Dakota pursue a very focused Technology-Based Economic Development Strategy (TBED) investment program targeted on leveraging and building state assets, much like Texas did with oil revenues following the oil-shocks of the 1970's and 1980's. To a certain extent, this recommendation is embedded in Goal 3 of the State's new economic development plan, and is being incorporated into the plan for the State Board of Higher Education. We are suggesting that North Dakota leadership adopt an expanded range of strategic TBED objectives.

Recommendation 2.0 – Build and Assign a Metrics Working Group to Report New Performance Measurements for the COE Program that Align with State Level TBED Metrics

2.1 – Gather and assign a small working group to build up a candidate set of linked performance measures that best fit State TBED needs and for reporting on the COE program. Some of the metrics discussed in this report are candidates for monitoring both state TBED progress and COE performance.

2.2 – Include reporting “average leverage” ratios to track total and industry investment leveraged by the state investment as core performance metrics for the COE program. North Dakota captures the basic data already, but the reporting does not focus on explaining the critical nature of “leverage” for achieving longer-term economic development objectives. Carefully documenting federal and private “leverage” trends is one of the better tools for tracking the value of state COE investments. It is among the best return on investment (ROI) metrics used by similar programs across the nation.

Recommendation 3.0 – Educate, Train and Provide Services in Intellectual Property (IP) Practices and Technology Transfer

Prepare specific materials providing detailed guidance about rules and procedures for IP management and technology transfer targeted to the COE programs and their industry partners in an effort to alleviate confusion and uncertainty. Standard contractual language should be made available that can be tailored to each COE and COE-related project reflecting partner objectives, state and institution management policies regarding IP, and the relevance of the Bayh-Dole Act assignment of IP ownership rights (see Recommendation 4.0).

Recommendation 4.0 – Monitor Federal Funding

Each university and COE should create a very transparent system to track and report applicable federal funding that would trigger the Bayh-Dole Act provisions for specific COE projects and proposals (provisions that under certain conditions would assign all project IP as university property regardless of the private sector contribution). Absent clarity, experienced firms will generally assume Bayh-Dole is in play, and may limit COE participation in the development of core technology, while inexperienced firms can end up in serious IP ownership disputes.

Recommendation 5.0 – Adopt a more integrated statewide technology management program

Adopt a more integrated statewide technology management program that can serve all campuses and COEs.

Recommendation 6.0 – Develop a COE-based “Proof-of-Concept” Program

Create a “proof-of-concept” fund within the COE program to help tease out commercial ideas that otherwise might be left on the table. It should have easy access--open submission or perhaps a quarterly cycle. This would open the program to earlier stage opportunities and perhaps induce smaller companies to participate. Key success factors for a proof of concept program must include:

- Provide small amounts of flexible funding to conduct testing, to validate the technology, and to determine whether it meets a market need at a competitive price
- Connect university inventors with entrepreneurs, investors, and commercial partners
- Encourage interactions between university researchers and industry to help identify commercially relevant research questions; ensure that researchers are aware of both developments in the marketplace and the technological challenges facing specific industries of special interest to North Dakota

Recommendation 7.0 – Add Independent Peer Review to the COE Proposal Process

Adding an independent peer review to the COE proposal process will be critical as the COE program moves forward. It is highly likely that future proposals will require increasingly technical review and more sophisticated evaluation of commercialization potential. We believe this will: 1) help to pre-empt potential future political challenges; 2) bring external feedback that can be used to significantly improve center operations and future proposals; and 3) expose North Dakota R&D and commercialization programs to a cadre of national experts. Peer review could be scheduled immediately following the Department of Commerce review phase.

Recommendation 8.0 – Reassess Matching Requirements

8.1 – Leadership should consider reassessing the 2:1 match requirement, either across the board, or specifically for smaller firms.

8.2 – Provide clear guidance on permitted in-kind match.

Recommendation 9.0 – Allow for Modest Overhead

Permit a modest overhead charge to universities on state provided COE funds (on the order of 5%-10%), since it is clear that some new costs are imposed by the COE program.

Recommendation 10.0 – Review Reporting Requirements

Center directors clearly view the reporting requirements as onerous and time consuming. They also report that the data the state wants them to collect from their private partners is part of the problem. Firms do not want to disclose detailed employment and wage data for competitive reasons. Discussions

with university leadership about reporting requirements suggest that Center directors may not be the best point for the reporting tasks. We see several lines of attack to help deal with this challenge.

10.1 – The Centers of Excellence Commission and the Department of Commerce should convene a working group of COE private sector partners and potential partners to explicitly discuss their perceptions of the COE program and its policies and procedures. This would build upon the survey of private participants conducted during the spring of 2010. Specifically it should seek their input on the best ways to collect the jobs and wage (and other) data that the State needs to report progress.

10.2 – Guidance documentation needs to be developed regarding reporting policies and procedures that become part of any contractual negotiation between a COE and a private party.

10.3 – These policies and procedures need to be built into the newly launched training program for COE directors and staff.

10.4 – Reduce part of the reporting burden by addressing additional streamlining, record consolidation and standardization procedures through the creation of an intranet site and adoption of tracking software. Documents and regular financial reports could be posted to the site upon their receipt so that an electronic file is easily and remotely available to Department of Commerce staff and Commission members. Among others, Indiana's 21st Century Research and Technology Fund uses such a secure reporting vehicle.

Recommendation 11.0 – Create a Targeted Eminent Scholar Program

North Dakota should give strong consideration to funding a complementary Eminent Scholar program specifically focused on priority industry sectors, tied to existing COEs, and linked to industrial experience and/or a commercialization track record. Such a program cannot be tied to competitive bidding rounds. It needs to be a flexible fund that can be called upon in response to emergent opportunities in a targeted recruiting strategy. Criteria must be flexible, but with very high minimum standards.

Recommendation 12.0 – Create a Small Business Focused Grant Program

As discussed in the body of the report, the COE program contains elements that tend to create barriers to smaller firms. From the perspective of the state's development strategy, there is high value in engaging young, smaller firms in the COE program. Along with the proof-of-concept program noted above (Recommendation 6.0), which is not specifically small business focused, TPMA recommends creating a small business focused grant program that:

- Reduces match requirements for smaller firms on existing grants.
- Offers a separate competitive grant fund for the COE to engage smaller firms.
- Provides matching grants to firms that have won a competitive Federal SBIR grant. The purpose of such a match is to support movement along the commercialization pathway.

Recommendation 13.0 – Create a Federal Funding Match Initiative

We recommend that North Dakota create or reserve a portion of future COE funding for a state priority COE matching fund. This fund would be available to help provide local match to university centers which are seeking high value federal (and perhaps foundation funded) projects that meet the highest priority state economic development objectives. Criteria for award would have to be very clear. Among others, a state match must be critical to the prospects for success, and other university and private stakeholders must be willing to make a significant contribution as well.

Recommendation 14.0 – Strengthen Collaboration and Build Commercialization and Entrepreneurial Networks

Bridging the chasm between academia and industry ultimately requires the development of strong networks among academia, the COE program, private firms, and external sources of R&D funding and capital. Also critical is development of a deep culture of collaboration among researchers, COEs universities, and other outside partners. In a state as small as North Dakota, cross-COE, cross-institution, and academic/industry collaboration is extremely valuable in building a critical mass of talent in targeted clusters.

14.1 – We recommend that the Department of Commerce, working with the COE Commission, be assigned the responsibility to begin building a networking program around the state focused on linking COEs with firms in target clusters and key external sources of R&D, commercialization, and entrepreneurial funding and support.

14.2 – We recommend that strong incentives be placed in funding programs to encourage greater cross-COE, cross-institution, and academic/industry collaboration.

Suggested Sources

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G. Michael Alder, President, National Centers of Excellence, *State Technology Development and Commercialization Programs: A Survey of the States*, Original Study Release Date: September, 2005, Latest Study Update: March 1, 2006.

David F. Shaffer and David J. Wright, *A New Paradigm for Economic Development: How Higher Education Institutions are Working to Revitalize Their Regional and State Economies*, The Nelson A. Rockefeller Institute of Government, University at Albany, State University of New York, March 2010.

Appendices

Appendix A – Milken Institute Ranking

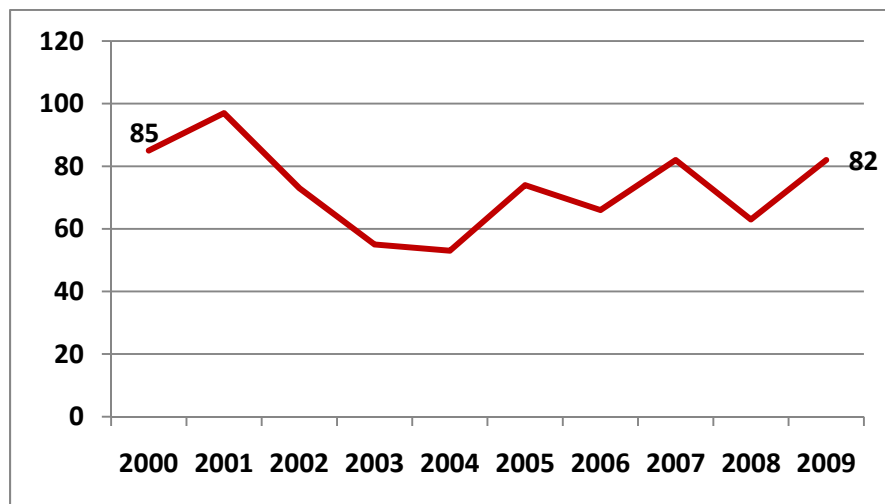
Milken Institute Ranking of North Dakota's R&D Input Composite*

Indicator	North Dakota's Rank		
	2008	2004	2002
Academic R&D per capita	3	14	25
Industry R&D per capita	19	44	44
Federal R&D per capita	30	36	34

*Actual data reported by the NSF lags 2-4 years

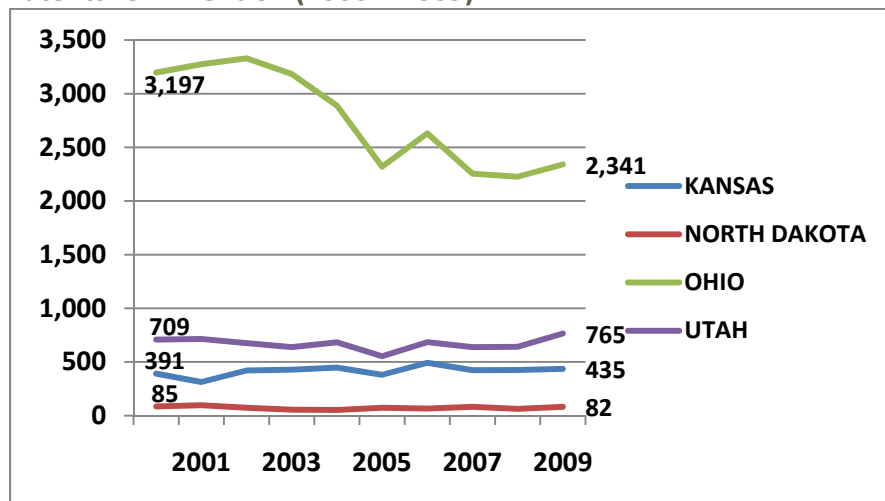
Appendix B – Data on Patents in North Dakota

North Dakota, Patents for Invention (2000 – 2009)



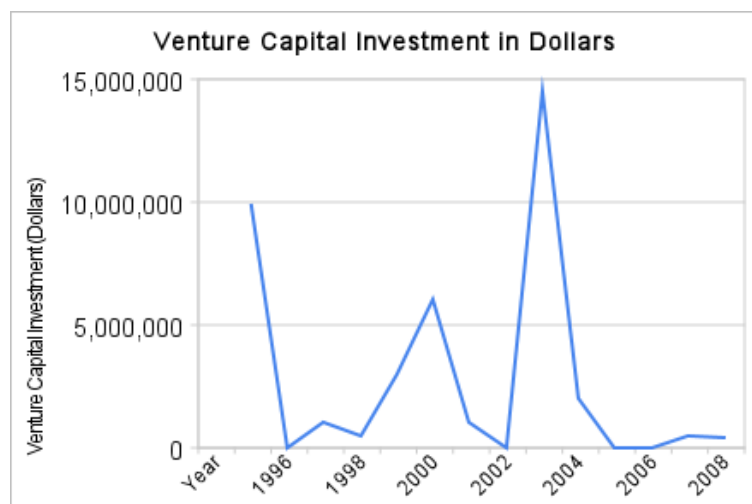
Source: U.S. Patent and Trademark Office

Patents for Invention (2000 – 2009)



Source: U.S. Patent and Trademark Office

Appendix C – Data on Venture Capital in North Dakota



Source: SSTI

Appendix D – NSF Scorecard on North Dakota

Science and Engineering State Profiles: 2006–08: NSF 10-302 | November 2009

Science and engineering profile: North Dakota

Characteristic	State	U.S. total	Rank
Employed SEH doctorate holders, 2006	1,380 [†]	620,140	49
S&E doctorates awarded, 2007	79	31,801	45
Life sciences (%)	46	26	–
Psychology (%)	23	10	–
Engineering (%)	10	24	–
SEH postdoctorates in doctorate-granting institutions, 2006	39	49,201	48
SEH graduate students in doctorate-granting institutions, 2006	1,799	542,073	45
Population, 2008 (thousands)	641	308,014	49
Civilian labor force, 2008 (thousands)	370	155,366	48
Personal income per capita, 2007 (dollars)	36,082	38,615	27
Federal spending			
Total expenditures, 2007 (\$millions)	6,766	2,532,073	49
R&D obligations, 2006 (\$millions)	112	107,545	47
Total R&D performance, 2006 (\$millions)	316	335,377	47
Industry R&D, 2006 (\$millions)	120	243,853	47
Academic R&D, 2007 (\$millions)	169	49,406	43
Life sciences (%)	45	60	–
Engineering (%)	25	15	–
Physical sciences (%)	10	8	–
SBIR awards, 2000–07	55	44,157	49
Utility patents issued to state residents, 2008	63	77,493	48
Gross domestic product, 2007 (\$billions)	28	13,832	51

[†]Coefficient of variation > 10% but < 25%; – = no value possible.

S&E = science and engineering; SEH = science, engineering, and health; SBIR = small business innovation research.

Federal obligations for research and development, by agency and performer: North Dakota, FY 2006

(Thousands of dollars)

Agency	Performer							Rank
	Total	Federal intramural	All FFRDCs	Industrial firms	Universities and colleges	Other nonprofits	State, local governments	
All agencies	112,067	27,370	0	2,361	74,623	7,706	7	47
Department of Agriculture	36,568	23,825	0	0	12,743	0	0	20
Department of Commerce	632	22	0	0	610	0	0	44
Department of Defense	16,283	345	0	1,661	14,277	0	0	48
Department of Energy	20,327	0	0	0	13,681	6,646	0	26
Department of Health and Human Services	14,908	0	0	556	13,285	1,060	7	49
Department of Homeland Security	2	0	0	2	0	0	0	43
Department of the Interior	3,307	3,122	0	0	185	0	0	28
Department of Transportation	870	56	0	22	792	0	0	40
Environmental Protection Agency	1,921	0	0	0	1,921	0	0	22
National Aeronautics and Space Administration	12,391	0	0	120	12,271	0	0	32
National Science Foundation	4,858	0	0	0	4,858	0	0	51
Rank	47	41	–	51	45	36	52	–

– = no value possible.

FFRDC = federally funded research and development center.

NOTES: Federal R&D obligations are as reported by funding agencies. Rankings and totals are based on data for the 50 states, District of Columbia, and Puerto Rico.

SOURCES: Prepared by the National Science Foundation/Division of Science Resources Statistics.

Appendix E – Description of COE-Related Organizations

Following is a detailed listing of all the approval organizations included in the process:

- Centers of Excellence Commission
- North Dakota Economic Development Foundation
- State Board of Higher Education
- Emergency Commission
- Legislative Budget Section Committee

Centers of Excellence Commission

The Centers of Excellence project is overseen by a Commission comprised of members from the North Dakota Economic Development Foundation and the State Board of Higher Education. The Centers of Excellence Commission manages the application process, makes funding recommendations for projects, and oversees the monitoring of the Centers.

State Board of Higher Education

The eight-member State Board of Higher Education is the policy-setting body for the North Dakota University System. The board includes seven citizen members appointed by the governor who serve four-year terms and one student appointed by the governor for a one-year term. A non-voting faculty advisor is selected by the Council of College Faculties.

North Dakota Economic Development Foundation

54-60-04. North Dakota economic development foundation – Executive committee - Duties. The North Dakota economic development foundation is created.

1. The foundation is composed of a minimum of fifteen and a maximum of thirty members appointed by the governor for two-year terms, except the governor shall appoint approximately one-half of the initial foundation members to one-year terms in order to initiate a cycle of staggered terms. Appointment of the foundation members must ensure a cross section of business, tourism, and economic development representation, and must ensure that at least one member represents rural concerns.
2. The foundation members shall elect an executive committee with a minimum of five and a maximum of seven foundation members, which shall include a chairman, vice chairman, secretary, treasurer, and up to three members at large.
3. The foundation shall seek funding for administrative expenses from private sector sources and shall seek and distribute private sector funds for use in commerce-related activities in the state.
4. The foundation shall:
 - a. Provide the governor advice and counsel in selecting the commissioner.
 - b. Serve in an advisory role to the commissioner.
 - c. Develop a strategic plan for economic development in the state and set accountability standards, measurements, and benchmarks to evaluate the effectiveness of the department in implementing the strategic plan.
 - d. Develop a strategic plan for the development of value-added agriculture in the state.
 - e. Monitor tourism and economic development activities and initiatives of the department.
 - f. Recommend state and federal legislation relating to strengthening the state's economy and increasing the state's population.
 - g. Monitor state and federal legislation and initiatives that may impact the state's economy and population.

h. Serve as a source of expertise for developing public and private initiatives to strengthen the state's economy and increase the state's population.

Emergency Commission

This statutory body is organized under the Secretary of State's office and consists of the following state policymakers:

- Governor who is the chairman,
- the Secretary of State who also serves as the commission's secretary,
- the Majority Leader, ND Senate, and
- the Majority Leader, ND House of Representatives,
- the chairman of the Senate Appropriations Committee, and
- the chairman of the House Appropriations Committee.

The Emergency Commission has the following general authority and responsibility:

- Approve transfers between funds or line items in agency budgets;
- Order funds paid from a contingency fund appropriated by the legislature;
- Take action when there is an imminent threat to the safety of people due to a natural disaster or war crisis; or an imminent financial loss to the state;
- Authorize the acceptance and disbursement of federal funds or other funds not appropriated by the legislative assembly which are made available by any federal agency or other source and which the legislative assembly has not indicated an intent to reject.

Legislative Budget Section Committee

By law, some of the decisions made by the Emergency Commission also need subsequent approval of the Legislative Budget Section Committee. For example, the Emergency Commission which has authority to approve agency requests for line item transfers, for acceptance of additional federal and other funds, and for use of state contingencies appropriations would require Budget Section approval for transfers or additional spending of federal or other funds exceeding \$50,000.

Therefore, the regular meetings of the Emergency Commission are usually scheduled seven to 14 days prior to meetings of the Legislative Budget Section Committee, which usually meets four times a year. However, as needed, special meetings of the Emergency Commission can be held at the call of the Governor.